

# Survey of Approval Practices for Onsite Sewage Treatment Systems in Ohio<sup>1</sup>

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**ABSTRACT.** In 1997, a survey of all county and local health departments was conducted to learn more about the use of onsite wastewater treatment systems. The goal of this study was to assess approval practices for onsite wastewater treatment in Ohio. The survey results indicate limited use of modern site evaluation techniques to determine site suitability for onsite wastewater treatment systems. System selection is not closely tied to site characteristics. In over 70% of Ohio's counties the onsite sewage systems are designed by the person issuing the permit. The lack of land-use planning is cited as a major obstacle to protecting public health and local health departments are looking for state leadership to make the local regulators' job easier.

OHIO J SCI 99 (3): 38-43, 1999

## INTRODUCTION

In Ohio, over 950,000 homes rely on septic systems and other on-site wastewater treatment units to renovate and dispose of wastewater (Bureau of Census 1990). Permits for wastewater treatment systems serving single family homes, two-or three-family dwellings are issued by local health departments (Section 6111.04 Ohio Revised Code).

Rules for the siting, design and construction of on-site sewage systems have been developed by the Ohio Department of Health (Section 3701-29 Ohio Administrative Code). While the Ohio Board of Health adopted minimum standards in 1977, local health departments can adopt more stringent standards. Over the 20 years since the state code was written, local health departments have developed their own unique programs which bring together aspects of local experience, political and development pressures, new products and research advances. A 1987 survey of local health departments revealed the inconsistent nature of regulation of onsite sewage systems across Ohio (Mancl 1990). That survey also discovered that 25 counties were issuing permits without even visiting the site to make an assessment of suitability.

Septic tank-soil absorption systems are a common type of onsite sewage treatment system. Sewage from the home, about 50 gallons per person per day, enters a large, underground tank where solid material and greases separate from the sewage and are retained. The clarified wastewater then flows into a series of shallow soil trenches in the yard called a soil absorption system. As the wastewater is absorbed into the soil it is renovated by naturally occurring microorganisms that colonize the soil matrix. In Ohio, a minimum of 66 inches of soil depth above bedrock or groundwater is required to install a soil absorption system. Also the soil must have an adequate percolation rate, which ranges from 3 to 60 minutes for an inch of water to soak into the soil.

If the soils on a lot are not suited for a soil absorption

system, the Ohio Administrative Code (Section 3701-29) lists provisions for alternative on-site systems, including curtain drains, sand filter systems and aerobic systems. The code specifies that curtain drains, installed six inches below the trench bottom, eight feet away can be used in areas with a seasonally high water table. Other systems, such as mound systems and evapotranspiration systems, are considered experimental, requiring a variance from the Ohio Department of Health for installation.

Much has been published on the design, construction and performance of alternative wastewater treatment systems since Ohio standards were published in 1977. Curtain drain placement to lower a seasonal high water table was analyzed by Okeke and others (1981). They developed a mathematical model to determine necessary curtain drain depths. To lower a water table in a clay loam soil to a depth of 170 cm (68 inches), a curtain drain would need to be installed at a depth on 360 cm (144 inches). A three year experiment was conducted by Nieber and others (1998) to demonstrate the effectiveness of auxiliary drainage in a silty clay loam soil for an on-site septic system. A soil absorption system was constructed in a soil with a seasonally high water table at 18 inches beneath the surface. A drain tile installed at a depth of 244 cm (96 inches) at a distance of 3.1 m (10 feet) from the nearest trench and drained to a county drainage ditch successfully lowered the water table to below 175 cm (70 inches). This work points out the weakness of the 1977 Ohio standard for very shallow placement of curtain drains. Placement of curtain drains at a depth 6 inches lower than the trench bottom would not result in a 66 inch deep unsaturated soil layer needed to install a soil absorption system.

Another alternative for sites with at least 24 inches of soil depth to a limiting condition is to augment the existing soil with a layer of specially selected sand to create the necessary soil depth for wastewater treatment. These systems, called mound systems, were presented in a design and construction manual first published at the University of Wisconsin by Converse in 1978. In the 1980s mound systems were used in a few Ohio counties as an experimental system using the Wisconsin design manual.

<sup>1</sup>Manuscript received 27 October 1998 and in revised form 14 April 1999 (#98-16).

A survey of 133 mound systems constructed in Clermont County, OH (Ingram 1991) found that 95% of the systems were functioning. To facilitate consideration of mound systems as a wastewater treatment alternative, Ohio State University Extension published two manuals on mound siting, design and construction in Ohio (Widrig and Mancl 1990; Mancl and Gustafson 1992). However, since mound systems are not included in the Ohio Administrative Code (Section 3701-29), they are still considered experimental and would require a variance before use.

Evapotranspiration of wastewater on individual lots is a novel alternative for Ohio. Since these systems are not included in the Ohio Administrative Code (Section 3701-29), they would also require a variance before use. Developed as a mounded area on a lot, evapotranspiration systems are sometimes called mound systems. This creates confusion when asking about the application of the two technologies which became evident following a 1987 survey of septic systems in Ohio (Mancl 1990). Throughout Ohio, trees are routinely planted on evapotranspiration systems. Trees are not to be planted on mound systems because tree roots can damage the buried wastewater distribution system. So the use of trees is one easy way to distinguish evapotranspiration systems from mound systems. Bondurant (1984) analyzed the application of evapotranspiration systems for Ohio. He concluded that since the net gain of precipitation which falls in Ohio over the water evaporated and transpired is 6 inches of water per year, evapotranspiration systems cannot function.

Aerobic systems to renovate wastewater have been applied widely in Ohio in areas with soils considered unsuitable for soil absorption systems. A 1987 survey (Mancl 1990) reported aerobic systems in use in 96% of Ohio's counties. Aerobic systems are a smaller version of an activated sludge wastewater treatment plant. As wastewater flows through a multiple chamber tank, the wastewater is continually stirred and sludge is returned. While many systems sold in Ohio come with a two-year service agreement, long term care and maintenance of these mechanical treatment plants is not required.

Sand filters are also used to treat wastewater in areas with soils considered unsuitable for soil absorption systems. Sand filters are a smaller version of a trickling filter where septic tank effluent is applied to the surface of a bed of sand and microorganisms colonize the surface of the sand particles. As wastewater flows through the sand it is treated by the microbial film that coats the sand particles. Sand filter construction standards were included in the 1977 Ohio Administrative code (Section 3701-29). Sand filter design recommendations were updated and expanded in a manual prepared by Mancl and Rector (1999).

The goal of this study was to assess approval practices for onsite wastewater treatment in Ohio. The objectives were to learn how site and soil evaluations are conducted, how systems are selected and designed, and how local health department staff members are keeping up-to-date on issues regarding onsite wastewater treatment.

## MATERIALS AND METHODS

A 21-question survey was prepared using the procedure described by Dillman (1978). Printed as a 5 1/2 x 8 1/2 inch booklet, the questionnaire consisted of a front cover illustration and 7 pages of multiple-choice and fill-in-the-blank questions. Prior to distribution, the questionnaire was tested by two sanitarians to insure that the questions were clear and appropriate. The complete questionnaire is available from the author.

Following Dillman's technique, the surveys were distributed to all 88 counties through a four-part mailing process. The first mailing contained a personally addressed and signed cover letter, the questionnaire booklet and a pre-addressed and stamped return envelope. After 2 weeks, a reminder postcard was sent to all. Two weeks later a second letter, the questionnaire booklet, and a return envelope were sent to all who did not respond. Finally, 2 weeks later, a second reminder postcard was sent to all who had not responded.

Following the collection of the surveys, a results booklet was produced. The results booklet was sent to all health departments in thanks for their participation in the survey. After the results booklet was mailed some additional surveys were returned.

## RESULTS

Surveys were sent to all county health departments beginning 15 May 1997 with eighty (91%) county health departments responding. County health departments issued an average of 250 permits in 1996 ranging from 50 to 693 permits per county.

Site and soil evaluations are the first step in developing an onsite sewage treatment system. Two assessments must be made to determine soil suitability; the soil depth to a limiting condition and the soil permeability. Determinations of soil depth to a limiting condition must be made by direct observation of the soil profile. This is only possible by excavating the soil, usually as a back-hoe pit, so an individual can examine the soil profile. Auger holes give limited access to soil profile observations, but are useful in observing some aspects of the limiting conditions of the site.

Figure 1a summarized the techniques used to determine soil depth to a limiting condition. Only 38% of county health departments use back-hoe pits to make their determinations. Another 14% use auger holes. A limited assessment is made in 14% of the counties by examining 1 inch diameter cores collected with a soil probe on the site. Thirty-two percent of counties do not even visit the site to determine soil depth to a limiting condition before issuing a permit. Twenty-three percent do consult the county soil survey map. While a useful tool, county soil surveys produced by the Soil Conservation Service (1994) are general maps useful in planning. Because great differences in soil properties can occur in a short distance, these maps alone are not suitable for selecting a site for a structure. Finally, 10% of counties make no determination of soil depth to limiting condition.

The second assessment needed to determine soil suitability is permeability. Percolation tests and observations

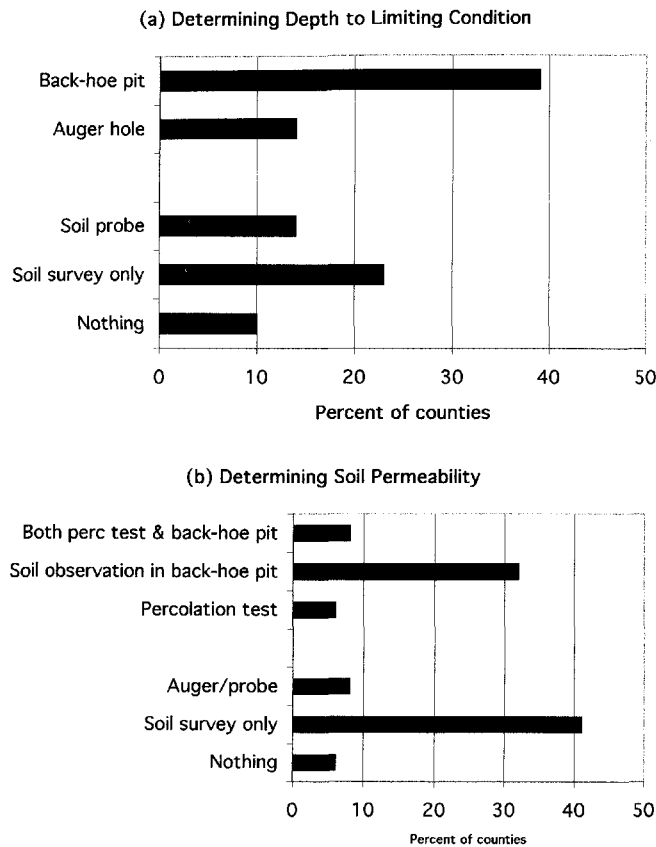


FIGURE 1. Techniques used by county health departments to evaluate sites and soils for suitability for onsite wastewater treatment.

of soil structure, texture and consistence are two methods of estimating the soil's permeability. Forty-seven percent of counties use one or both of these techniques (Fig. 1b). Forty-one percent rely of soil survey maps only, which, as stated in the county soil survey document (Soil Conservation Service 1994), are not suitable for this use. Eight percent visit the site and make some assessment using probes or auger holes. No determination is made in 6% of counties.

In nearly every county, 96%, the county sanitarian determines site and soil suitability. Only 5 counties use trained soil scientists to evaluate sites routinely. However, 52 counties (65%) require an evaluation by a certified soil scientist in certain situations. Soil scientists are required for evaluating sites for new subdivisions in 18 counties. Six counties require an evaluation by a certified soil scientist if the published county soil survey is unclear and 2 counties require soil scientist evaluations for disturbed or reclaimed sites. In addition 14 counties recommend certified soil scientists to homeowners appealing a health department decision on a system.

County health department officials were asked if sites are ever considered unsuitable for on-site wastewater treatment. As shown in Figure 2, most (65%) rarely deny a permit, where rarely indicates less than 5% per year are denied.

System selection based on site conditions is the second step in developing an onsite wastewater treatment system. In the survey, county health department staff

were presented with three theoretical cases and asked to indicate what type of system they would select. The findings are presented in Figure 3.

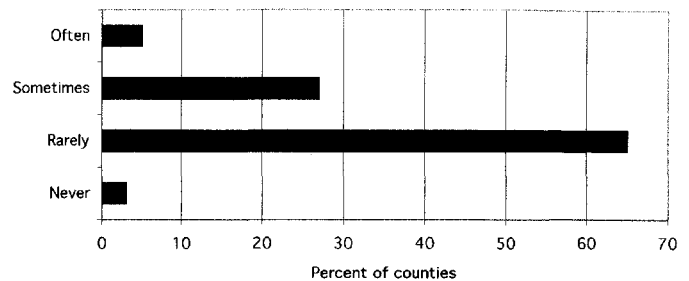


FIGURE 2. Frequency with which sites are considered unsuitable for on-site wastewater treatment with permits denied by county health departments. Rarely means less than 5% per year, sometimes is 5% to 25%, and often is more than 25% per year.

All three situations were considered unsuitable for soil absorption systems due to shallow depth to a limiting condition and low soil permeability. Some counties would have appropriately denied a permit for some of these sites with only 1 county denying permits for all three. For each site, some of the counties indicated they would approve a soil absorption system. Six percent would have approved a soil absorption system for a site with shallow depth to bedrock, 16% would have approved a site with shallow soils to a fragipan and 3% would have approved a site with shallow soils to a seasonal high water table.

The responses show the heavy reliance on the Ohio practice of using shallow curtain drains at 6 inches beneath the bottom of the system trenches. As noted by Okeke and others (1981) and Nieber and others (1998) curtain drains must be placed at depths greater than 6 feet beneath the soil surface to lower the water table to provide an adequate depth of unsaturated soil necessary for wastewater treatment. Five percent would have approved a soil absorption system with curtain drain for a site with shallow depth to bedrock, 33% would have approved a site with shallow soils to a fragipan and 36% would have approved a site with shallow soils to a seasonal high water table.

One of the sites would have been appropriate for mound systems with fragipan present at a depth of 36 inches and soil permeabilities of 0.6 inches per hour, and 13% of counties would have correctly used this alternative technology on this site. Twenty-seven percent of counties would have incorrectly permitted mound systems in slowly permeable soils of 0.2 inches per hour and 4% of counties would have incorrectly permitted mounds in very slowly permeable soils of 0.06 inches per hour. Only 1 county health department would have approved a mound system where appropriate and denied permits on unsuitable lots.

Permitting systems that discharge to a ditch, storm sewer or field drainage tile is also a common practice. From 16% to 32% would permit the discharge of treated wastewater to a drainage way. Figure 4 indicates how

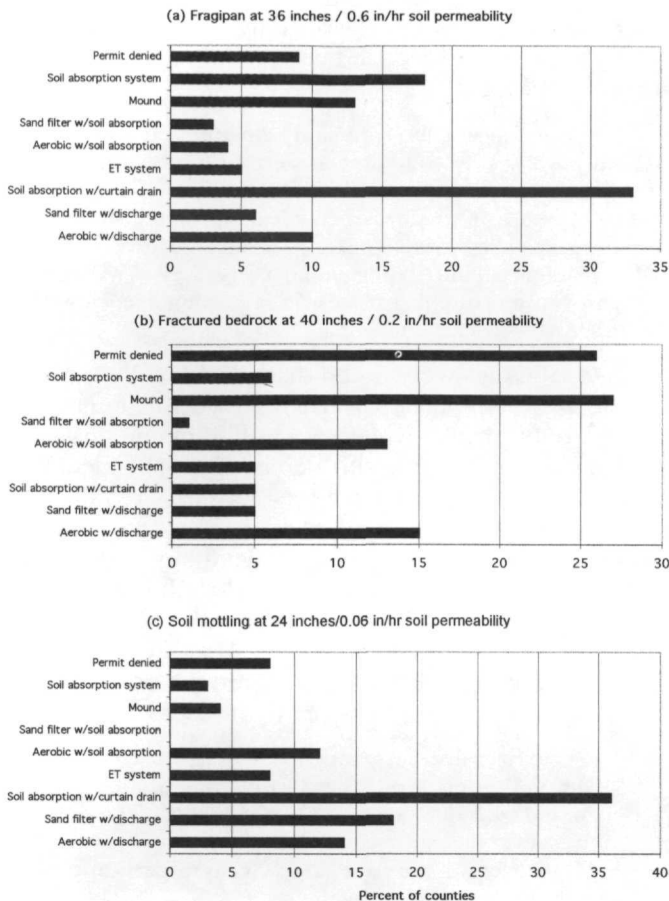


FIGURE 3. System selection by county health department when presented with 3 different site and soil conditions. All are not suitable for soil absorption systems. The site with fragipan at 36 inches and 0.6 in/hr soil permeability is suitable for a mound system.

often counties issued permits for off-site discharge and also how often they require disinfection of the treated wastewater prior to off-site discharge. Only 33% of counties always require disinfection prior to surface discharge. Twelve counties require disinfection if discharging to an intermittent stream or ditch, 5 counties if the discharge is close to another dwelling, 3 counties if the soil is very slowly permeable, and 2 counties require disinfection on all aeration units.

The design is the third step in developing an onsite wastewater treatment system. Figure 5 shows who usually designs systems for use in Ohio. In 50% of the counties, systems are designed by the same person that issues the permit for the system and in an additional 24% of counties the person issuing the permit assists in the design. No other public health or environmental program has such a practice, where the designer also approves the permit for the system they design. Only 5% of counties require an independent consultant to design the system. In 31 counties (40%) a consultant designs systems in some situations such as for a variance in 3 counties, for subdivisions in 6 counties, for mound and experimental systems in 5 counties and for poor soils or small lots in 7 counties.

Mound systems have been constructed in 25 counties in the three years 1994 to 1997. As shown in Figure 6, these

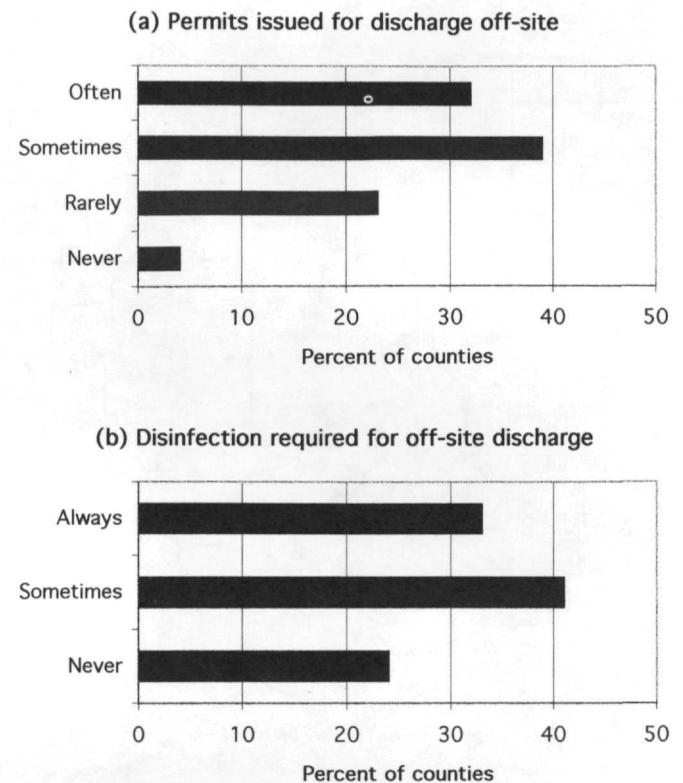


FIGURE 4. Frequency of issuing permits for off-site discharge of treated wastewater among county health departments. Also the extent of disinfection prior to off-site discharge of treated wastewater. Rarely means less than 5% per year denied, sometimes is 5% to 25%, and often is more than 25% per year.

counties use design manuals published by the University of Wisconsin (Converse 1978), The Ohio State University (Widrig and Mancl 1990), or both, as the basis for their design. Fifteen different counties installed evapotranspiration systems over the same 3-year period (Fig. 6).

Keeping up-to-date on issues regarding onsite wastewater treatment is an important activity for local health department staff. Figure 7 indicates the most common events and information sources used by county health department staff. Conferences and workshops sponsored by professional groups and Ohio State University are the most popular. The newsletter published by the USEPA National Small Flows Clearinghouse is also used to help staff. The internet and world wide web are used by 18% of counties.

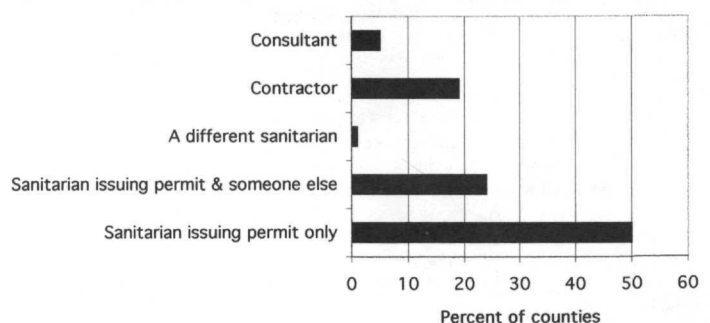


FIGURE 5. The person who usually designs onsite wastewater treatment systems permitted by county health departments.

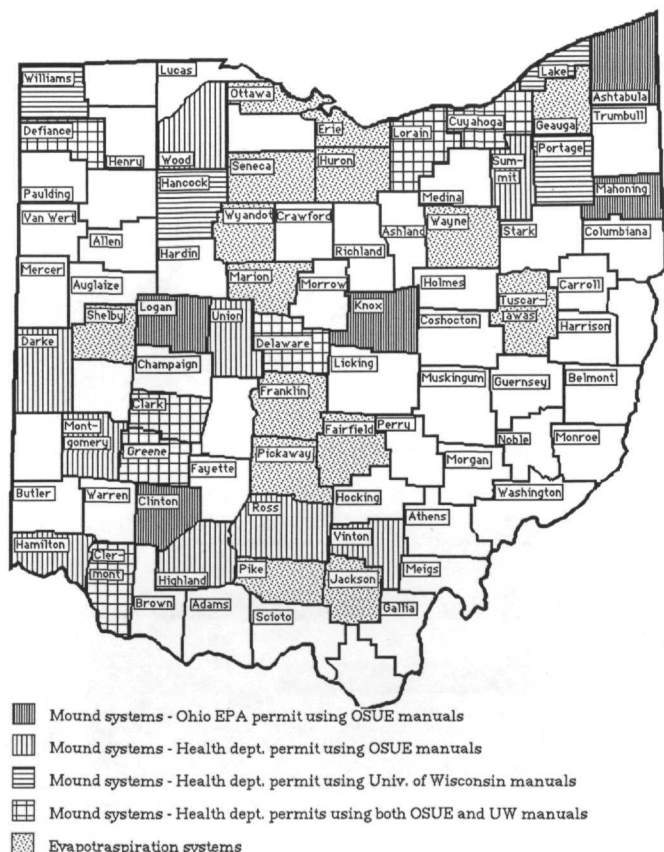


FIGURE 6. Permits for mound systems and evapotranspiration systems issued 1994-1997. Median cost of a mound system is \$11,000.

Finally in looking ahead to the next 3 to 5 years, local health departments were asked to identify major obstacles, what would make their job easier and other issues related to onsite wastewater treatment programs. Local health department staff identified eight major obstacles. Lack of alternatives, system operation and management, the need for new state rules, governmental agency and political conflicts, costs, lack of local infrastructure and the need for public education were all

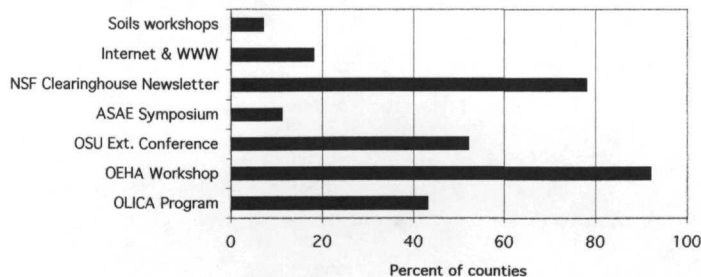


FIGURE 7. Events and resources used by county health departments to keep up-to-date with issues related to onsite wastewater treatment. Ohio Land Improvement Contractors Association (OLICA) hosts a 2-day basic design program annually. Ohio Environmental Health Association (OEHA) hosts 1- to 4-hour sessions on onsite sewage systems at some of their annual meetings. OSU Extension hosts an annual 8-hour program on new technologies in onsite sewage management. American Society of Agricultural Engineers (ASAE) hosts a 2-day national research symposium every 4 years. The National Small Flows Clearinghouse (NSF) publishes and distributes a newsletter on advances in onsite wastewater treatment. Half-day soils workshops are conducted by the Natural Resources Conservation Service.

identified as major obstacles. The most frequently noted obstacle is the lack of land-use planning. Some of the comments were:

"Over concern about all land being utilized for housing purposes. Not all land is suitable for housing developments."

"Pressure from developers, realtors, and township trustees to allow development in unsuitable areas."

"Marginal lands going under construction. Cost of land and pressure that places on regulating agencies to 'approve' sites for building."

Several issues were noted that would make it easier for public health officials to balance their role in protecting the public health while not creating undue obstacles and hardships. Local health department staff identified eight things that would make their jobs easier. Increased funding, local support and planning, more alternative technologies, maintaining local flexibility, improving local infrastructure, more public education and training, and soil evaluation assistance were all identified as ways to make their job easier. Most identified the need for more state level leadership in the onsite wastewater treatment program. Some of the ideas were:

"Make rules that can be applied over the state equally. When one county works hard to provide a good program, and others are doing less, there is not good progress for the environment."

"Only way we will have countywide inspection program is if it is mandated by the state."

## DISCUSSION

The objectives of this study were to learn how site and soil evaluations are conducted, how systems are selected and designed, and how local health department staff keep up-to-date on issues regarding onsite wastewater treatment. This survey helps to quantify how onsite sewage systems are being developed in Ohio and where future training programs should be directed.

The survey results showed limited use of modern site and soil evaluation techniques. Health departments are not requiring the expertise of trained soil scientists to conduct site assessments. In 26 counties, permits are issued without a visit to the site. This is the same result reported from a similar survey conducted in 1987 (Mancl 1990).

System selection is not closely tied to site characteristics. Over 70% of counties would permit inappropriate systems when presented with site characteristics. One technology available for shallow, slowly permeable soils is a mound system. Detailed siting and design manuals for mound systems have been available since 1978 and specifically for Ohio since 1990. In the 3-year period preceding the survey, only 25 of the 88 counties permitted mound systems. One unsettling survey result was that some counties would have permitted mound systems on sites for which they were not suited. Careful system selection across Ohio appears to be lacking.

In over 70% of Ohio's counties, onsite sewage systems are designed by the person issuing the permit. This unusual practice eliminates the opportunity for checks and balances between system designer and system regulator.

Only four counties usually require that systems be designed by an independent design professional that is not the builder or a regulator.

Most county health department staff are taking advantage of the educational opportunities available to them. Conferences and workshops appear to be the most popular. Distance learning techniques, like the internet, show little use to date.

Local health departments face many obstacles as they work to protect the public health from the discharge of untreated sewage. Land-use issues stand out as an obstacle in addition to the training, technology and regulatory issues that would be expected. Local health departments are looking for state leadership to help make their job easier along with local support, improved technology, and training.

## CONCLUSIONS AND RECOMMENDATIONS

The goal of this study was to assess the practice of onsite wastewater treatment in Ohio. This survey illustrates that the programs implemented by local health departments lack uniformity, modern practice and technology, and do not have in place a system of checks and balances to protect the public health from the approval of inappropriate sewage treatment systems.

Health departments throughout Ohio rely heavily on the approval of unproven technologies, such as shallow (6-inch deep) curtain drains and evapotranspiration systems, and tend to misapply proven technologies such as soil absorption and mound systems. If this trend continues, coupled with inadequate land-use controls, Ohio's rural areas will see a real decline in public health and environmental well being. Since the discharge of raw sewage is directly linked to the transmission of water-borne disease, the threat of outbreaks is present without improved rural sanitation.

The regulations for home sewage systems, adopted in 1977, have not been updated. It is clear that an update is needed and is called for by local health departments. Training in site evaluation, soil assessment and system selection also is needed statewide. Workshops are the most popular, but the survey indicated that only half of the counties' staff are participating in multi-day training on onsite sewage systems. More in-depth and hands-on

field training is needed to reinforce the links between site evaluation, system selection, system design and long term performance.

More research is needed to better assess the detailed training needs of onsite wastewater treatment professionals. Also more research should be conducted on the environmental impact of the use of shallow curtain drains and evapotranspiration systems.

**ACKNOWLEDGMENTS.** Salaries and research support provided by State and Federal Funds appropriated to the Ohio Agricultural Research and Development Center, The Ohio State University. Additional support was provided by Dr. Robert Gustafson, Chair Food, Agricultural and Biological Engineering, OSU. The assistance of Rita Bowers in conducting this survey is greatly appreciated.

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